CLAIMS

What is claimed is:

1. A brake actuator for a disk brake system having a brake disk and a caliper, comprising:

a master cylinder body defining a fluid reservoir;

a piston mounted to the master cylinder body, wherein the piston is movable relative to the master cylinder body between an extended position and a retracted position, wherein the piston and the master cylinder body are configured such that movement of the piston to the extended position displaces a quantity of fluid to operate the caliper in a first direction, and movement of the piston toward the retracted position returns a quantity of fluid toward the fluid reservoir through a pressurized fluid flow path defined by the piston and the master cylinder body; and

a pressure relief valve arrangement interposed between the fluid flow path and the reservoir for controlling the flow of fluid to the reservoir upon movement of the piston between the extended and retracted positions, wherein the pressure relief valve arrangement is configured and arranged to selectively vent fluid from the fluid flow path to the fluid reservoir in the event pressure in the fluid flow path exceeds a predetermined threshold.

2. The brake actuator of claim 1, wherein the pressure relief valve arrangement includes a valve body defining an internal cavity in communication with the fluid flow path, wherein the valve body includes a relief port in communication with the fluid reservoir.

3. The brake actuator of claim 2 further comprising a biased valve member movably mounted within the internal cavity, wherein the valve member is movable to an expanded position against the bias to accommodate introduction of fluid from the fluid flow path into the

internal cavity upon movement of the piston toward the retracted position, and to an at rest position under the influence of the bias to discharge fluid from the internal cavity to the fluid reservoir through a discharge port associated with the master cylinder body upon movement of the piston toward the extended position..

4. The brake actuator of claim 3 wherein the valve member in the expanded and at rest positions prevents communication between the internal cavity and the fluid reservoir through the relief port.

5. The brake actuator of claim 5 wherein the valve member is further movable from the expanded position to a relief position against the bias when the pressure in the fluid flow path exceeds the predetermined threshold to enable fluid to flow from the internal cavity to the fluid reservoir through the relief port, to relieve the fluid pressure in the fluid flow path.

6. The brake actuator of claim 2 wherein a fluid tight seal is established between and among the internal cavity, the master cylinder reservoir, and a master cylinder cartridge passage.

7. The brake actuator of claim 1 wherein the master cylinder includes a timing port for establishing communication between a master cylinder cartridge passage and an internal cavity defined by a pressure relief valve arrangement valve body.

8. The brake actuator of claim 1 wherein the master cylinder includes a backup port for establishing communication between a cartridge passage and an internal cavity defined by a pressure relief valve arrangement valve body.

9. A method of relieving fluid pressure exceeding a predetermined threshold in a fluid flow path associated with a disk brake system having a master cylinder including a body and an extendible and retractable piston, wherein the master cylinder body includes a fluid reservoir,

comprising the step of selectively establishing fluid communication between the fluid flow path and the fluid reservoir when the fluid pressure in the fluid flow path exceeds the predetermined threshold to alleviate adverse effects on the brake system resulting from excessive pressure in the fluid flow path.

10. The method of claim 6, wherein the step of selectively establishing fluid communication between the fluid flow path and the fluid reservoir is carried out via a pressure relief valve arrangement interposed between the fluid flow path and the fluid reservoir, wherein the valve arrangement includes an internal cavity in communication with both the fluid flow path and the fluid reservoir, and a movable biased valve member disposed within the internal cavity that is operable to control the flow of fluid between the internal cavity and the fluid reservoir.

11. The brake actuator of claim 1, wherein the pressure relief valve equalizes pressure in the master cylinder so as to reduce a knockback condition.

12. The brake actuator of claim 1 wherein the valve body is capable of being bled integrally with the master cylinder reservoir.

13. The brake actuator of claim 1 wherein the valve body has a direct fluid communication path with the master cylinder reservoir.

14. The brake actuator of claim 1 wherein the arrangement includes a major bias member and minor bias member and wherein the arrangement has an assembled at rest state wherein the valve piston compresses the minor bias member and does not compress the major bias member.

15. The brake actuator of claim 1 further comprising a cap which is secured to an upper end of the valve cylinder.

16. A pressure relief valve assembly in combination with a master cylinder, the combination comprising:

a master cylinder having a master cylinder reservoir; and

a pressure relief valve assembly positioned within the master cylinder reservoir, the assembly comprising:

a pressure vessel for displacing a fluid, the pressure vessel comprising:

a valve body;

a generally u-shaped cup seal disposed adjacent the valve body; and

a piston in sealing contact with the generally u-shaped cup seal ;

a first spring located adjacent the pressure vessel piston;

a second spring adjacent the pressure vessel piston and concentric with the first spring; and

a cap in engagement with the first spring;

wherein the second spring is preloaded to have a higher installed force and a higher spring rate than the first spring.

17. The pressure relief valve assembly and master cylinder combination of claim 13 wherein, when the piston moves to contact the first spring, compress the first spring, and compress the second spring, fluid is drawn into the pressure vessel, thereby relieving a knockback pressure from the master cylinder reservoir.

18. A method of reducing caliper piston knockback using a brake master cylinder, the method comprising:

displacing a pressure relief valve assembly piston to contact and compress a first spring and a second spring concentric with the first spring, thereby drawing a fluid into a pressure vessel; and

transferring the fluid from the pressure vessel to a reservoir located within the master cylinder, thereby reducing caliper piston knockback.